AFM studies on $BiFeO_3$ single crystals and thin films

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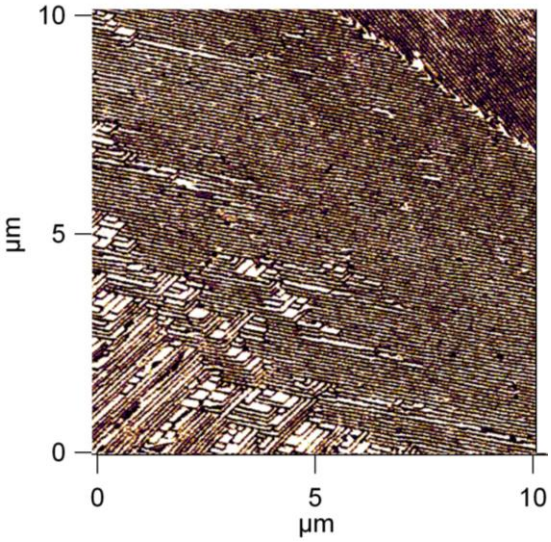
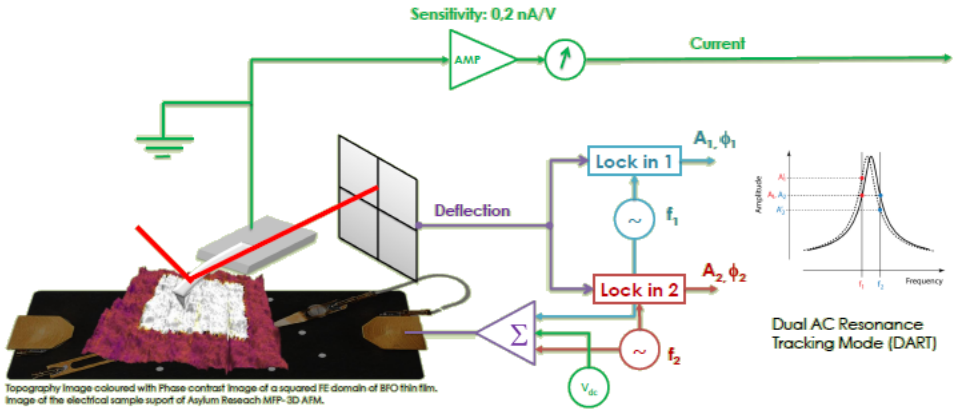
Bismuth ferrite is a paradigmatic multiferroic material since it is both magnetic and a strong ferroelectric at room temperature [1]. This material shows many interesting phenomenolgies, among which we will focus on the discovery of a surface layer different from the bulk that was found in big single crystals of $BiFeO_3$ [2] and the conductivity found in domain walls of $BiFeO_3$ thin films [3].

Surface of $BiFeO_3$ single crystals show a symmetry different than the bulk crystal: it undergoes its own phase transition at about 275 ºC and shows different electronic and structural properties. By using Asylum's heating stage option of MFP-3D AFM, we have studied the surface layer properties at the nanometer scale, paying special attention at the piezoelectric, electrical and mechanical properties of the skin before and after the transition, in various combined measurement modes. We will show the characteristic properties of these domains and the evolution of domain polarization with temperature up to 300 ºC, studied by temperature dependent AFM measurements.





On the other hand, domain walls on thin films of $BiFeO_3$ are interesting entities showing different electrical and magnetic properties than the domains in the thin films. Among this, room-temperature electronic conductivity at ferroelectric domain walls in the insulating multiferroic $BiFeO_3$ have been observed in domain walls corresponding to different crystalline orientations. Still, movement of the domain walls can also induce current signal due to charge displacement. Simultaneous PFM and c-AFM measurements of $BiFeO_3$ domain walls will be shown, and discussion about the mechanisms and the origin of this effect will be given.

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